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Information Needs and Behaviors - NASA Science Program Executives

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14. ABSTRACT This paper presents a case study of the information-seeking behaviors, needs, and information use of a small group of government science program executives (PEs). The study population is a small group of co-located individuals within one organization at NASA. The Science Mission Directorate manages NASA's unmanned space flight projects. Each flight project in development has a management team at Headquarters including a Program Executive, a Program Scientist, and a budget analyst. A Program Executive works together with this team to define, integrate, and assess program activities and to provide policy direction and guidance to the program. All the individuals in the study population have the same job description, expectations, governing policies, and work resources. Studying this group provided an opportunity not only to describe their information behaviors and preferences but to compare the results with research describing the norms of engineers and executives.				
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Introduction

This paper presents a case study of the information-seeking behaviors, needs, and information use of a small group of government science program executives (PEs). Studies have reported on the needs of engineers as information users (Fidel & Green, 2004; Hertzum & Pejtersen, 2000; Leckie, Pettigrew, and Sylvain, 1996), as well as business executives (Auster & Choo, 1994; Boyd & Fulk, 2001; de Alwis, Majid, & Chaudry, 2006; Wetherbe, 1991). This group is a melange of the two: engineers by training and executives by work task.

Engineers' information needs vary depending on the task they have to accomplish (Hertzum & Pejtersen, 2000). They first seek information from other people (Hertzum & Pejtersen, 2000), preferably through informal channels (de Alwis et al., 2006) but also require information from journals, standards documents, and technical specifications (Hertzum & Pejtersen, 2000). Engineers prefer to use information sources that they are familiar with (Fidel & Green, 2004), and they are frequent users of their organizational library (Hertzum & Pejtersen, 2000). Business executives do not generally frequent libraries or use academic journals (Auster & Choo, 1994). Like engineers, they prefer to obtain information from people, most frequently from their direct subordinates (Auster & Choo, 1994). Executives often scan their external environment for information (Auster & Choo, 1994; de Alwis et al., 2006), and time spent scanning increases as task complexity increases (Boyd & Fulk, 2001). Executives' information needs are constantly changing; each decision requires a new set of information (Wetherbe, 1991).

The study population is a small group of co-located individuals within one organization at NASA. The Science Mission Directorate (SMD) manages NASA's unmanned space flight projects. Each flight project in development has a management team at Headquarters including a Program Executive (PE), a Program Scientist, and a budget analyst. A Program Executive works together with this team to define, integrate, and assess program activities and to provide policy direction and guidance to the program (NASA Office of the Chief Engineer, 2009). All the individuals in the study population have the same job description, expectations, governing policies, and work resources. A senior manager of the organization who oversees this group believes that the group often focuses too heavily on the technical side of their jobs, and hypothesizes that they behave "too much like engineers, not enough like managers" (SMD senior manager, personal communication, June 2009). Studying this group provided an opportunity not only to describe their information behaviors and preferences but to compare the results with research describing the norms of engineers and executives.

This study was designed to gather information about how PEs in the Science Mission Directorate seek information, their preferences about where to obtain information, and what kinds of information are most important to PE work.

Research Questions

The following research questions were addressed:

What are the demographics of NASA SMD Program Executives?

What work tasks do PEs perform?

What information sources do PEs find most important?

How do PEs seek information?

What is the relationship between PEs and their organizational library?

Methodology

A literature review was first conducted to determine the information seeking behaviors, needs, and preferences of both business executives and engineers. This review created interest in planning for this independent study. Through discussions with the study advisor, the research proposal was written, the study was planned, and preliminary information-gathering interviews were designed. The interview instrument was approved by the Institutional Review Board (IRB).

Two librarians and a library technician were interviewed to gather background information on PE information sources and their use. One PE was interviewed to gather background information about PE work tasks. Using information from the librarian interviews, the PE interview, and recommendations from SMD senior management, a survey instrument was drafted.

More data might have been gathered through interviews, however it was reasoned that a survey would result in data from a larger population. A survey was the chosen instrument for its potential breadth and speed.

The survey included questions about demographics (Q1-9), work locations (Q10-11), work tasks (Q12), information sources (Q13-23), information-seeking behaviors (Q24-26), relationship with the library (Q27-28) and two open-ended questions (Q29-30). The list of work tasks was obtained from the SMD Management Handbook (National Aeronautics and Space Administration [NASA], 2008). Information source options were created based on attendance at several "PE Forums" (informal monthly meetings of PEs and their senior manager), data from the PE interview, personal knowledge of the organization, and consultation with SMD senior management. Question 20 was designed to determine if and how PEs obtain historical program information. The library questions were written based on information obtained from earlier interviews of the library personnel.

The survey instrument was reviewed and rewritten several times through a co-editing process with the independent study advisor. The instrument was piloted with a university professor. Due to the very small population of potential respondents to the survey, it was not tested on a sample set of PEs. The survey instrument was approved by the IRB.

To get the maximum survey responses from this small population, the study was announced at the PE Forum meeting, and participation was encouraged and supported by SMD senior management. A senior manager arranged for the survey to be sent to the entire population of PEs via e-mail. It was distributed to thirty-eight individuals with an introduction and a link to SurveyMonkey, a web-based survey tool. Due to the time constraints of an independent study, the survey period was restricted to two weeks; more time, a prize incentive, or a more lengthy survey window might have yielded higher returns. A reminder e-mail was sent eight days after the initial distribution, and a final reminder several days later. The survey was held open for several days after the original deadline at the request of an individual PE.

Two recipients of the survey responded by e-mail that they no longer held the position of Program Executive. This reduced the population size to thirty-six. Twenty-two responses were collected and twenty-one were fully completed resulting in a 58% response rate.

The survey instrument is available in Appendix A.

Survey results

Demographics and Work Tasks

All but one respondent labeled themselves a Program Executive, and all but one responded "yes" to the question "are you a PE?". The twenty two respondents were evenly distributed across experience levels of 0-2, 3-5, 6-9, and 10+ years. The one outlier listed his/her title as "Manager," but reported that he/she had between six and nine years of experience as a PE. This response was included in survey results analysis; it is assumed that this individual had been a PE in the recent past. Each respondent was a civil servant. All four Science Mission Directorate Divisions were represented: Earth Science and Planetary had seven respondents each and Astrophysics and Heliophysics both had four. The majority (16) hold at least a Masters degree, just two hold only undergraduate degrees, four completed some graduate work, and three completed doctorates. All but two respondents have a degree in either engineering, physical sciences, or both. The two outliers have degrees in Mathematics, Business, or Computer Science & IT. A small number of respondents have Arts & Humanities degrees in addition to their engineering or physical science degrees. The respondents are between the ages of 40 and 59 except for one who was between 60 and 69. Two fifths of the respondent population was female.

Programs are usually run out of a NASA Center other than Headquarters. Twelve respondents are responsible for programs run out of both Goddard Space Flight Center (in the Washington Metro area) and the Jet Propulsion Laboratory (JPL, in Pasadena, CA). All but four respondents have at least one program managed out of a Center requiring air travel. Twelve respondents (55%) travel between one and five days per month, eight (36%) travel less than once per month, and two travel between six and ten days per month. One PE noted that "Lack of travel budgets makes it near impossible for me to attend quarterly project meetings." Another noted that he/she visits Goddard Space Flight Center, Wallops Flight Facility, and Langley Research Center more frequently because of their proximity.

Respondents were asked to report how frequently they perform ten specific tasks as a Program Executive. Over 90% reported that they frequently monitor, report, and keep track of program/project status, and maintain their network and working relationships. Eleven (50%) noted that they frequently make decisions for or about their program, however seven said decision-making was rare. One comment noted that PEs do not make decisions, they make recommendations. The table below shows the number and percentage of responses for each rating of each task.

Table 1: PE Work Task Frequency Ratings

Please indicate the tasks you perform as Program Executive	Never	Rarely	Sometimes	Frequently
Monitoring and reporting program/project status			1 (5%)	21 (95%)
Assessing program performance (including "gate" reviews)		2 (9%)	7 (32%)	13 (59%)
Formulate new missions	6 (27%)	4 (18%)	10 (45%)	2 (9%)
Budget formulation		3 (14%)	10 (45%)	9 (41%)

Maintaining network, working relationships				22 (100%)
Liaising with other organizations (both internal and external)			7 (32%)	15 (68%)
Writing & managing FADs, PCAs, and other programmatic documentation	1 (5%)	5 (23%)	8 (36%)	8 (36%)
Providing policy guidance to program		2 (9%)	10 (45%)	10 (45%)
Keeping track of program activities/status			2 (9%)	20 (91%)
Making decisions for/about the program	1 (5%)	7 (32%)	3 (14%)	11 (50%)

Information Sources

Ratings of fifty-five information sources were organized in order of average rating of importance (see Table 2.1 below). Six of the ten most highly rated information sources were people. Project personnel (2.91), a PE's Division Director (2.86), Program Scientists (2.82), and Resources Analysts topped the list. The most important information sources other than people were SMD publications (2.68) and the ScienceWorks home page (2.50) (a portal page for a collection of SMD Information Systems). The five lowest-rated sources, excluding the "other" categories, were the NASA HQ librarians (0.77), HQ library books (0.73), NRC Action Tracking System (0.68), ASK Magazine (0.64), and SMD Spacebook (0.36). The table below shows all information sources according to their average rating of importance.

Table 2.1: Information Source Average Ratings – Importance (High to Low)

0 – Not at all 1 – Low 2 – Moderate 3 – High		
Information Source	Type	Rating Average
Project personnel	People	2.91
Your Division Director	People	2.86
Program Scientists	People	2.82
Resource Analysts	People	2.77
SMD publications (e.g. Mgmt Handbook, Science Plan, etc.)	Text	2.68
Other PEs from your division	People	2.64
Center Program Offices personnel	People	2.64
Informal meetings (e.g. "hallway meetings")	Meetings	2.55
ScienceWorks home page	SMD IS	2.50
Center project meetings (e.g. Project Office meetings)	Meetings	2.50
SMD Front Office (DAAs, AAs, Chiefs)	People	2.48
Google	Websites	2.36
Division staff meetings	Meetings	2.32
Center project review meetings (e.g. MSRs)	Meetings	2.32
Your project's or program's home page	Websites	2.27
Secretaries/Administrative Assistants	People	2.19
SMD Web site (nasascience.nasa.gov)	Websites	2.00
PAO team	People	2.00
NODIS (nodis.gsfc.hq.nasa.gov)	Websites	1.95
Colleagues outside of NASA	People	1.95
PE Forum	Meetings	1.91
NASA Portal (nasa.gov)	Websites	1.86
Weekly Reporting System	SMD IS	1.86
SMD shared drives	SMD IS	1.86
Milestones	SMD IS	1.77
Other PEs from other divisions	People	1.77

Information Source	Type	Rating Average
NASA-sponsored conferences	Meetings	1.68
Non-NASA conferences	Meetings	1.67
Requirements Management System	SMD IS	1.64
Trade magazines	Text	1.59
Newspapers	Text	1.55
Personal books (including non-NASA library books)	Text	1.45
International Agreements Database	SMD IS	1.45
SMA	People	1.45
Academic journals	Text	1.41
All Hands meetings	Meetings	1.41
OCE team	People	1.27
Procurement team	People	1.23
ITA	People	1.23
OGC team	People	1.18
Marshall SMD Web site (science.nasa.gov)	Websites	1.14
SOMD colleagues	People	1.14
NASA HQ librarians	People	0.77
HQ library books	Text	0.73
NRC Action Tracking System	SMD IS	0.68
ASK Magazine	Text	0.64
SMD Spacebook	SMD IS	0.36

Respondents were asked to consider meeting tools like meeting minutes, and audio and video conferencing tools. Five respondents (23%) reported that meeting minutes are never or rarely available, thirteen (59%) reported that they sometimes made available, and four (18%) said minutes are often made available. Thirteen (59%) said that minutes are either often or always useful, nine (41%) reported that they are sometimes useful, and no one said that minutes are either never or rarely useful. Over 77% found audio and video conferences to be often or always useful (18, 17 respectively), but only 9% find it easy to use video conferencing tools. One respondent noted that he or she depends "on others to set up video-conferences" and another reported that "Video conference controls seem overly complex and almost impossible to help troubleshoot when problems occur."

When asked what information sources were the most useful during a significant risk event, the average responses rated meetings, status reports, and colleagues as the most useful (rated over 4 in 0-5 scale) and Standing Review Board reports and SMD web applications moderately useful. Press and NASA websites were rated much less useful (< 2). The table below shows the average ratings of each source.

Table 3: Sources of Information for Use During Program Risk

What were the most useful sources of information for evaluating and managing the risk?	0 – Not at all useful 5 – Extremely Useful
Meetings	4.52
Status reports	4.14
Colleagues	4.10
Standing Review Board (SRB) reports	3.67
SMD Web applications	2.29
NASA web sites	1.95
Press	1.42

One question was designed to gather information about retrieving historical program data. Six (27%) respondents agreed that information from past programs is easy to obtain while fourteen (64%) disagreed (see Table 4, below). All but one respondent agreed that historical

program data is useful. Eight (36%) respondents reported that they do not have the tools they need to preserve information about their programs. There were two interesting comments offered in response. A respondent wrote, "preserving information is difficult and corporate knowledge is often lost when there are changes of PE." Another PE noted that "SMD has only a minor document repository."

Table 4: Storing and Accessing Historical Program Data

Think about the tools you use and how effective they are for your needs.	Agree or Strongly Agree	Disagree or Strongly Disagree
When I need information from a past program, it is usually easy to obtain.	33%	67%
Historical program data are useful to me.	95%	5%
Historical program data are easy to find.	29%	71%
I feel that there are ample opportunities to share work stories with colleagues.	65%	35%
I have all the tools I need to communicate information about my program.	86%	14%
I have all the tools I need to preserve information about my program.	62%	38%

Center Monthly Status Reports (MSRs) and Center Weekly Written Reports (Weeklies) are regular reports generated by the Center project teams for Headquarters use. These two reports were evaluated according to eight adjectives. Over 90% of respondents reported that the MSRs were consistent, reusable, easy to use, and accurate. Eighty percent thought that the MSRs were efficient and valuable, 71% found them information rich and easy to locate.

Table 5.1: Ratings of the Center Monthly Status Reviews (MSRs)

MSRs	Yes	No
Accurate	90%	10%
Consistent	95%	5%
Easy to locate	71%	29%
Easy to use	95%	5%
Efficient	81%	19%
Information rich	71%	29%
Reusable	95%	5%
Valuable	86%	14%

Eighty percent or more of the respondents felt that the Weeklies are consistent, reusable, efficient, and valuable, 75% said they are useful, and 70% reported they are easy to use. Thirteen of the twenty respondents (65%) felt that the Weeklies are information rich or easy to locate. One respondent does not have access to the Weekly Reports, another said that his or her ratings were based on the best of the Center reports he receives, but that they are not all equal. One respondent mentioned that the reports are not interesting from a Headquarters perspective

and another noted the report is "too high level for my use."

Table 5.2: Ratings of the Center Weekly Reports (Weeklies)

Weeklies	Yes	No
Useful	75%	25%
Consistent	79%	21%
Easy to locate	65%	35%
Easy to use	70%	30%
Efficient	85%	15%
Information rich	63%	37%
Reusable	79%	21%
Valuable	80%	20%

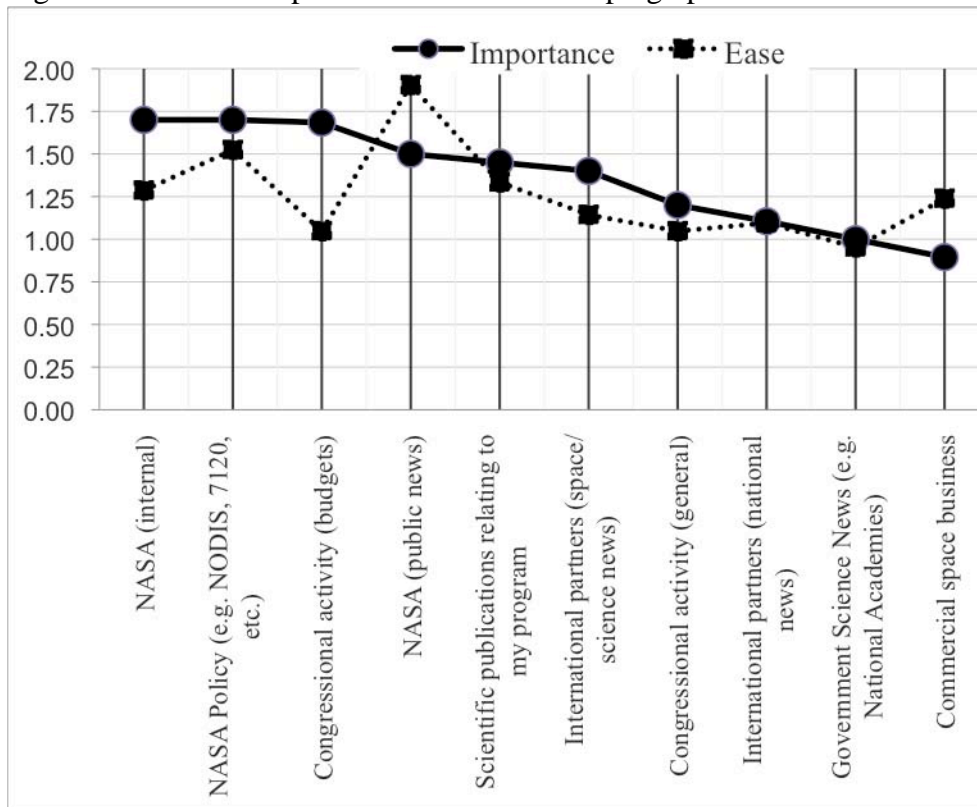
Four specific categories of information were assessed according to their reliability. Technical information was reported as the most reliable (3.38 of 4), programmatic information was slightly less reliable (3.10), and schedule and resources were evaluated as the least reliable (2.90 and 2.86, respectively). All four types were rated as "usually" reliable by the majority of respondents, four individuals feel that schedule and resources information are sometimes reliable, and one respondent selected that resources information is never reliable. Interesting comments included in the responses: "The nature of flight projects on development is very dynamic and may change faster than a weekly basis;" "...two year money is really one year money and gets to the programs very late;" "Risk reporting is often weak, typically lacking insight on implications of risk occurrence and recovery;" and that "the answers would be different for project versus program information."

Information-Seeking Behavior

One question was designed to determine how PEs obtain information from other people. There were eight communication mechanisms, including four computer-mediated methods. The most likely method was to "send an email," and the next three highest-rated were non-computer mediated communication types (phone calls or scheduled and impromptu meetings). PEs are not at all likely to broadcast a message, post on a message board, or send an instant message. It should be noted that this response did not indicate preference for but rather likelihood of use. Two PEs indicated that they would use IM and other media (social networks or SMS) if their colleagues did as well, or if their projects adopted the technologies.

Two questions were posed to measure the PEs' estimation of how important and how easy it is to "keep up" with various information sources. Respondents reported that internal NASA news (1.70 of 2) and policy (1.70) were the most important while government science and commercial space news (1.00 and 0.89) were least important. On average, all of the information sources listed were rated as at least somewhat important. One respondent felt that science publications relating to his/her program were not at all important. Each source was reported to be relatively easy to keep up with; on average the sources were all somewhat easy to keep up with. The table below shows each kind of information with its importance rating versus the effort that keeping up with it requires.

Figure 1 shows the importance and ease of keeping up with the listed information categories.



Library Use

Several questions measured PE awareness and use of the Headquarters management and policy library. The first question asked about their library use in the past month. Thirteen (62%) respondents reported that they did not use the library. One respondent reported using the library three to four times per week. The balance of the PEs (33%) reported using the library between one and five times in the last month. Thirteen (65%) respondents reported that they are aware of the services that the HQ library provides; seven (35%) did not. Two respondents commented that, while they do not frequently use library services, when they do the service is "EXTREMELY valuable" and "most helpful." In an open-answer comment at the end of the survey one PE noted "HQ Library may be valuable...[but] I simply have not taken the time to research what is available there." Another reported that "I probably could use [the library] more often, but I just don't think to do it, or the pace of my work day tends to discourage me from taking the time to use it." The table below shows how the PEs who were aware of the library use (or do not use) its services.

Table 6: Library Services Use

Library Services	Agree or Strongly Agree	Disagree or Strongly Disagree
I use the library staff to help with literature reviews.	50%	50%
I use the library staff to facts and data in a hurry.	31%	69%
The library provides vital information for my job.	42%	58%
I like to visit the library to get away from my desk.	33%	67%
I use the library to get materials through Interlibrary Loan.	46%	54%

To allow for responses that we had not provided for in structured survey responses, two free-form answer questions were given. Respondents were asked to fill in the blank: "If I had better access to _____, it would make my job much easier." The responses included:

- "Real-time project schedule information"
- "Travel funding"
- "Project and program documents"
 - "other program documentation"
 - "project documentation databases"
 - "Project day-to-day work product files--like presentations and reports...My project needs a good configuration management person, and/or system that would allow me to access project information on my own, rather than always needing to interface with project personnel to get it."
 - "Historical Program information (Pre-electronic)"
 - "Project technical status information and meetings"
 - "Meetings and technical forums"
- "ViTS [video teleconference system] and Webex [web conference service]"
- "Fewer passwords and systems"
- "Congressional budget bill status"
- "SMD AA's decisions", "SMD information"
- "The major science journals (ApJ, AJ, MNRAS, A&A, JGR, etc.)"
 - "more science web journals"
- "detailed budget information"
 - "budget and schedule data"

The following are answers to an open ended question at the end of the survey. It reminded the respondent of the types of information that were asked about in the course of the survey and asked for any further comments.

1. HQ Library may be a valuable source of information. I simply have not taken the time to research what is available there.
2. Budget and schedule data are not readily available. I must request these. They should be posted in one publicly available website for all to use simultaneously. Don't understand why we are keeping schedule and budget data so secret."

"In general, these questions focus on how we currently access and use information. But it seems to me that the current methods are haphazard in some respects and could be more efficient or more effective. Much of this depends on proper use and adoption by PEs and project personnel. One of my previous projects used blogs, instant messaging, and a good configuration management system (and config manager) with great success. I always knew where to go for information and who to contact to get it if I couldn't find it on my own. My current projects do not have this kind of use of systems."

"Library provides an important service to HQ"

"No information is provided by the library staff to the new people"

"A better, easier, online, consistent archiving system would be great. Also, the ability to easily scan and store documents electronically. Paper is unwieldy and unnecessary and should be made obsolete."

"Expand the online access to e-journals"

"I like having the library around, but as a PE, I don't use it often. Program Scientists have noted they need access to certain journals that the Library does not have subscriptions to."

Discussion

Demographics and Work Tasks

This study was designed to look at what was assumed to be a homogeneous group. As expected, the respondents were middle-aged and almost all engineers, 60% male, 40% female, and all hold (or have recently held, in the case of one) the same job. Contrary to expectations, PEs do not all do the same job. As represented by the survey responses, PE work tasks are not consistent. Some PEs formulate new missions and make decisions, some do not. Some write programmatic documentation, some do so only rarely. The Leckie et al. (1996) information-seeking behavior model of professionals shows that information-seeking is affected by users' work roles and associated work tasks. It is not surprising, therefore, that their information-seeking behaviors and source preferences are inconsistent within the group.

A cross-tabulation (cross tab) analysis was attempted to determine whether there is a clear difference in preferences between respondents with PhDs versus those without, but there were only three respondents who fell into this category. Consequently, there were an insufficient number of respondents to control for other demographic factors and therefore the cross tab could not be used. Similarly, an organizational division cross tab was not possible because two of the four divisions had only four respondents.

Information Sources: Texts, Websites, Organization Information Systems, and External

Published texts were rated of just average importance compared to the rest of the sources listed. This might have been anticipated given the fast pace of PE work. When examined by individual respondent, data showed that their responses were mixed. Three PEs thought newspapers were not at all important to their work, and yet three rated newspapers highly. The individual PEs' average rating of texts, excluding SMD publications, ranged from 0.14 to 2.57. This indicates that there are some individual PEs who prefer to use texts more than other PEs.

ASK Magazine was expected to be an important information source. ASK stands for "Academy Sharing Knowledge," its sub heading reads "The NASA Source for Project Management and Engineering Excellence" and it is currently edited by a prominent knowledge

management researcher, Lawrence Prusak (ASK Magazine, 2008, 2009abcd). It is not, however, a publication that PEs find important. It is possible that the focus of the magazine is too low-level to be useful to PEs at Headquarters, but it is striking that the magazine is placed second to last on the information sources table.

Not surprisingly, "Google" was the top-rated website source; it is synonymous with the public internet. NASA Watch should have been an option within the question, as several added it in their comments. Program executives find their project websites important, which implies that public project websites are populated with information useful to internal audiences. The HQ SMD website was rated of moderate importance, which is similarly surprising due to its public-facing nature.

The SMD HQ social networking tool, Spacebook, was the lowest-rated information source overall. It was reasonable to assume that a social networking site might be useful to PEs so that they may have better access to people in their networks. Project personnel, the most highly-rated information source, are off-site; Spacebook could be used as an additional tool for keeping in contact. However, upon further consideration of the demographics of this population, lack of social networking use should not come as a surprise. A study by the Pew Internet & American Life Project found that only 11% of respondents aged 50-64 and 25% aged 30-49 have ever used a social networking tool, and only 2% and 9% reported having used this kind of tool in the last 24 hours (Lenhart, 2009). Program Executives, all between 40 and 70 years old, might not be inclined to use social networking tools on the job until they become more familiar with them outside the work context. Further research might determine other reasons why this tool is not used by or is not important to PEs, and whether it could be made useful. A follow-up survey or interviews could be conducted to probe whether PEs are comfortable using social network sites.

The ScienceWorks home page is the gateway to program status reports, requirements, and milestones documentation. It was in the top ten most highly rated information sources overall. While they do not use a social network tool, this group does use information systems. In addition to ScienceWorks and its components, SMD's shared drives are available for storing and sharing program and project information within HQ. The respondents' median rating of this source indicates that they are probably more likely to ask others for information than to search for it on the drives. We cannot infer the definitive cause of the neglect, but it is possible that the drives may not have much information, may be too limited to access from outside of HQ, or they may be especially difficult to use. In addition to the systems mentioned in the survey, ten other information systems managed outside of HQ were identified in comments. These systems are not specific to the position of Program Executives, but rather to the programs they oversee. One respondent reported it is difficult to maintain awareness of and logins for a plethora of systems. PEs spend time "keeping up" with or scanning a variety of news environments. Respondents felt that NASA external news is the easiest source to keep up with. This was expected: each morning an SMD public affairs officer sends an e-mail with news clippings of NASA news from the previous day. Congressional budget activity was rated both highly important as well as somewhat less easy to collect. This is surprising: the library provides a congressional budget alert service (NASA Headquarters Library, 2009), however PEs are either unaware of the service, or it does not provide the type of budget information they require. Respondents reported that keeping abreast of NASA internal news is slightly difficult, but important. There is a trend across the ratings and comments that suggests program and project files are in disparate places, are hard to locate if they are historical, require many passwords to be

remembered, and that a change in program requires a change in information processes. Some PEs expressed the lack of available tools for preserving program information. The high use of ScienceWorks suggest that PEs are not generally opposed to using an online information system for program information, but they would like new processes or system features that can help organize and archive their information assets.

Information Sources: People and Meetings

Consistent with research on both business executives and engineers, PEs rated people the most important information sources overall. One respondent noted that it is particularly valuable to interface with PEs from other divisions who manage programs similar to his/hers, however this was an outlier. One manager at NASA (Russ Wertenberg, personal communication, Summer 2009) says that managers must maintain an awareness of the information from people one level above and two levels below them in the organization. Most of the highly rated information sources are people in positions either within the program team, project team (just below the program level), or the division director (the PE's supervisor). The other highest-rated human information sources were fellow PEs from one's own division.

PEs' prefer informal meetings to formal reporting mechanisms and regularly scheduled meetings. They find audio conferences and video conferences useful despite difficulty with the video equipment. Respondents noted several times throughout the survey that their travel funds are insufficient. This suggests that while virtual teleconferences supplement travel, PEs prefer seeking information from people in-person. PEs would benefit from the transformation of video and audio conference tools from arduous technical systems into easy, one-button services. The easier these tools can be made, the more likely they will be usable in informal meetings.

The majority of PEs find meeting minutes useful, yet they are not always recorded or made available. PE's high use of ScienceWorks indicates that if meeting minutes were posted there, they might provide value to the PE. Since meetings are fairly important, missing a meeting causes a PE to miss important information. For this purpose and for historical record, meeting minutes are of high importance.

Information-Seeking Behavior

The PEs were asked to rate their preferred sources of information during a risk event. The data showed that the most useful information was obtained in discussions with colleagues, but written status reports from centers or review boards were also important. Websites and press were rated much lower. This question only hints at the nature of information-seeking during a risk event, but it suggests that internal information is most useful.

PEs prefer to send e-mails, make phone calls, and knock on doors when they need a piece of information. These are common and established office communication mechanisms, unlike the newer tools such as Instant Messages (IM), message boards, tweets and other social media. There are a number of possible reasons that this is the case, but three comments from this section support the conclusion that at least some of the PEs would use these other tools if they were both available and if others knew how to use them. Since there are IM, blog, social network, and wiki tools available at NASA HQ, coordination of their use might be the problem.

Library Use

Studies show that though engineers use libraries, including in-house libraries, to obtain information (Leckie et al., 1996), executives are infrequent library users (Auster & Choo, 1994).

In this respect PEs behave much more like business executives than engineers. Out of eighteen possible human sources of information, the rating of HQ librarians was eighteenth. This is not, however, an indictment of the value of the library. Seven respondents were unaware of the services the library provides. Some respondents commented that they did not use the library often, but when they did it was extremely useful. The data indicate that library services are not well known. Fidel & Green (2004) found that engineers are unlikely to use a source that they are unfamiliar with. To make the best use of the library, its clientele must be both aware of its services and comfortable with their use.

From the interviews it was clear that PEs report themselves as indifferent library users, however the librarians did have some suggestions on how they would make changes that could increase PE patronage. For example, the librarians would like to add more science journals and databases to their collection, as well as initiate a library orientation program for new employees.

PEs expressed concern that new people in the Directorate are not made aware of the library. During interviews, the librarians expressed interest in learning more about PE information needs so that they may effectively promote library services and better serve the SMD population.

Conclusion

One PE made an observation about the survey design that is important to consider while interpreting all this data: "In general, these questions focus on how we currently access and use information." Indeed, the survey was designed to gather information about the current preferences and behaviors of Program Executives in the Science Mission Directorate. That task was accomplished: PEs behave much like business executives, and not like engineers in their library use. PEs need to have informal meetings with people more than anything else to do their job, but a variety of other sources are important and probably indispensable. They are not users of social networking sites or tools for work tasks, but they do use a number of web-based information systems. Above all, they value information from human sources.

The expectation that this population would be a homogeneous group proved false. SMD Program Executives do not fit squarely into a category of information users, such as engineers or business executives. Rather, they are individual users with unique sets of requirements, even among their own small population.

Headquarters librarians must increase their promotion and training of services. PEs are not reluctant to use the library, but they lack the familiarity that they need. Training should be mandatory for new PEs and probably all SMD employees. They have many other information sources and systems to juggle.

PEs ask other people for information first, even when they are just looking for a file that already exists. Program and project information should be organized so that it is easy to locate, especially sources like reports, which are produced on a regular basis and could be located in one place. Where organization already exists, it must be publicized. This may still not be enough. Information must be organized, publicized, and easy to access.

More research is needed to create a deeper understanding of PE information needs. Studies into program data archiving, program and project data management, schedule and resources data accuracy, and virtual meeting tools would benefit both the SMD senior management, and other organizations with similar information environments.

The SMD Management Handbook (2008) and policy directives describe the PE duties in detail, which indicated that PE work tasks would be much more standardized than they proved to

be. As work tasks vary, so do information needs (Leckie et al., 1996). However there is enough consistency in the data to conclude that PEs behave as expected for their position as executives.

References

- ASK Magazine. (2008, Fall). Issue 32. Retrieved December 16, 2009 from <http://askmagazine.nasa.gov/issues/32/index32.php>
- ASK Magazine. (2009, Winter). Issue 33. Retrieved December 16, 2009 from <http://askmagazine.nasa.gov/issues/33/index33.php>
- ASK Magazine. (2009, Spring). Issue 34. Retrieved December 16, 2009 from <http://askmagazine.nasa.gov/issues/34/index34.php>
- ASK Magazine. (2009, Summer). Issue 35. Retrieved December 16, 2009 from <http://askmagazine.nasa.gov/issues/35/index35.php>
- ASK Magazine. (2009, Fall). Issue 36. Retrieved December 16, 2009 from <http://askmagazine.nasa.gov/issues/36/index36.php>
- Auster, E., & Choo, C. W. (1994). CEOs, Information, and Decision Making: Scanning the Environment for Strategic Advantage. *Library Trends* 43 (2) 1994: *The Library in Corporate Intelligence Activities*: 206-225.
- Boyd, B., Fulk, J. (2001). Executive Scanning and Perceived Uncertainty: A Multidimensional Model. *Journal of Management*, 22, 1-21.
- de Alwis, G. Majid, S., Chaudry, A. (2006) Transformation in managers' information seeking behaviour: a review of the literature. *Journal of Information Science*, 32, 362-377.
- Fidel, R., & Green, M. (2004). The many faces of accessibility: engineers' perception of information sources. *Information Processing and Management*, 40, 563-581.
- Hertzum, M., & Pejtersen, A. M. (2000). The information-seeking practices of engineers: searching for documents as well as for people. *Information Processing & Management*, 36, 761-778.
- Leckie, G., Pettigrew, K., Sylvain, C. (1996). Modeling the Information Seeking of Professionals: A General Model Derived from Research on Engineers, Health Care Professionals, and Lawyers. *The Library Quarterly*, 66, 161-193.
- Lenhart, A. (2009) Adults and Social Network Websites. *Pew Internet & American Life Project*, January 2009. Retrieved December 13, 2009, from <http://www.pewinternet.org/Reports/2009/Adults-and-Social-Network-Websites.aspx>
- National Aeronautics and Space Administration. (2008). *NASA Headquarters Science Mission Directorate (SMD) Management Handbook*.
- NASA Headquarters Library. (2009). *NASA Headquarters Library: Subscribe to Alerts*. Retrieved December 16, 2009, from <http://www.hq.nasa.gov/office/hqlibrary/request/alerts.htm>
- NASA Office of the Chief Engineer. (2007-2012) *NASA Procedural Requirements: NASA Space Flight Program and Project Management Requirements*. Chapter 3. Retrieved December 15, 2009, from http://nodis3.gsfc.nasa.gov/displayDir.cfm?Internal_ID=N_PR_7120_005D_&page_name=Chapter3
- Wetherbe, J., (1991). Executive information requirements: getting it right. *MIS Quarterly*, 15, 51-65.